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RADIATION HYDRODYNAMICAL SIMULATIONS OF CEPHEIDS

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Cepheids are an important part of the cosmic distance ladder. With the advent of new, extremely large optical telescopes such as the E-ELT on the one hand and precision astrometry from space with GAIA on the other a more detailed knowledge of their physics beyond the classical results has become important even beyond the fields of stellar astrophysics and hydrodynamics themselves. To explain double-mode pulsation and the red-edge of the classical instability strip and their dependence on metallicity without resorting to adjustable parameters that appear in simplified models of convection appears highly desirable. A detailed study of the convection-pulsation interaction based on numerical radiation hydrodynamical simulations provides an alternative to traditional, one-dimensional models with their high number of up to eight free parameters. Other interesting questions which can be studied with such simulations are related to the photospheric dynamics of Cepheids characterized by strong shock fronts and a net mass outflow. An analysis of such features may also help to reduce systematic errors introduced in parameter determinations of Cepheids which are still largely based on classical, hydrostatic model atmospheres. In this talk results from such a study of the convection-pulsation interaction in Cepheids and of the dynamical properties of their photosphere are reported. To this end the ANTARES hydrodynamical simulation code has been developed which can tackle the difficult numerical challenges underlying such simulations. These challenges and methods how to deal with them are briefly reviewed before simulation results and results from a first analysis of a short period Cepheid are presented.